Recap of 21 June 2013 Severe Bow Echo

Event Synopsis

Early Friday morning on 21 June 2013 a line of thunderstorms developed and formed a line as it raced southeastward across Minnesota and Wisconsin. This type of storm complex has a bow-like signature on radar, so it is often referred to as a bow echo. The bow echo damaged buildings, trees, and caused significant power outages. The technical term for this type of bow echo is a *Quasi-Linear Convective System (QLCS)*. These QLCS thunderstorm complexes are often capable of producing very strong straight line winds across a large area. At times a QLCS will have short-lived low level circulations that mark areas of enhanced wind damage. The main ingredients needed for these systems are instability, and low level wind shear. This system had both of those ingredients, and produced a measured wind speed of 85mph at Benson, which is equivalent to that of a low end EF0 tornado. The damage reports received from Swift, Pope, and Stearns counties were consistent with such wind speeds.

Latest Wind Reports

LOCATION	SPEED	TIME/DATE
BENSON	85	0133 AM 06/21
MORRIS MUNI - CHARLIE SCHMIDT	68	1246 AM 06/21
BUFFALO	66	0314 AM 06/21
PAYNESVILLE MUNICIPAL AIRPORT	64	0213 AM 06/21
PRINCETON	60	0311 AM 06/21
CRESCENT LAKE #1	57	0420 AM 06/21
GLENWOOD	56	0144 AM 06/21
FLYING CLOUD AIRPORT	55	0335 AM 06/21
3 E LAKE ELMO	55	0405 AM 06/21
1 ESE ROUND PRAIRIE	54	0335 AM 06/21
ALEXANDRIA CHANDLER FIELD AIRP	54	0106 AM 06/21
ST. CLOUD REGIONAL AIRPORT	53	0417 AM 06/21
2 SE SAUK CENTRE	53	0255 AM 06/21
MUNICIPAL APT	52	0454 AM 06/21
NEW RICHMOND	51	0415 AM 06/21
1 ESE CAMBRIDGE	50	0336 AM 06/21
7 N GRANITE LEDGE	49	0518 AM 06/21
1 WSW ROBBINSDALE	49	0337 AM 06/21
ST PAUL DOWNTOWN AIRPORT	47	0402 AM 06/21
MINNEAPOLIS	47	0411 AM 06/21
MINNEAPOLIS-ST PAUL INTL AP	47	0349 AM 06/21
1 NNE FREDERIC	47	0650 AM 06/21
2 E SKYLINE	46	0418 AM 06/21
APPLETON	46	0153 AM 06/21
HUTCHINSON	45	0314 AM 06/21
SOUTH ST PAUL MUNI -RICHARD FL	45	0354 AM 06/21
6 WSW WYOMING	45	0406 AM 06/21
MINNEAPOLIS CRYSTAL AIRPORT	45	0341 AM 06/21

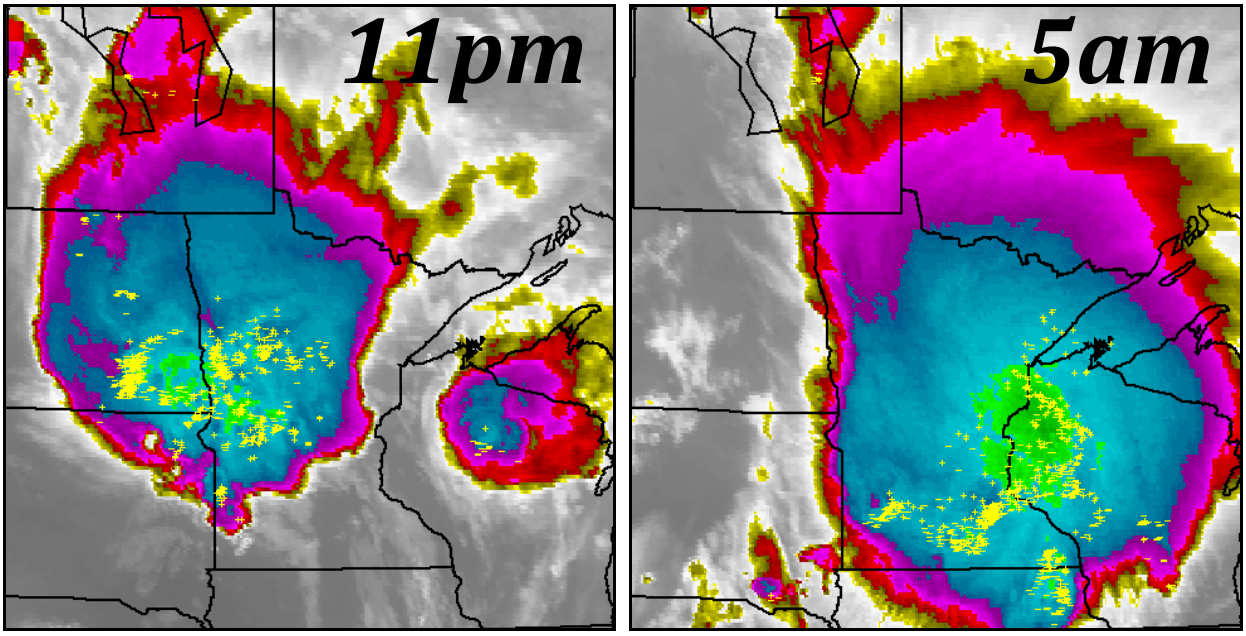

Figure 1: The two pictures above show Infrared Satellite Imagery (pink, blue, green shading) and lightning (yellow) from 11pm (left) and 5am (right). This satellite product detects emitted temperatures from cold cloud tops of the thunderstorms whose strong updrafts extend over 50,000ft above ground level. Meteorologists use this product to help track the intensity of thunderstorms that form at night.

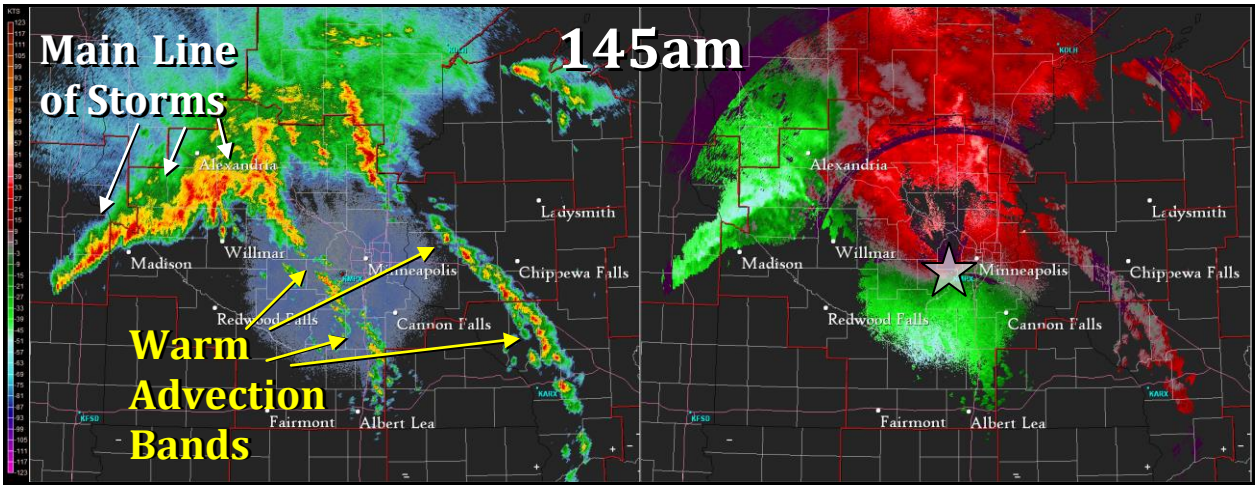

Figure 2: The radar picture from 145 am shows base level reflectivity (left) and velocity (right). In reference to the right left image, the main line of storms was located northeast of Madison and Willmar (white arrows). However, there were two thin band of storms that developed ahead of the main line of storms (yellow arrows). These thin bands are indicative of a storm complex that is strengthening. In reference to the right image, the green colors show wind blowing towards the radar, and the red colors show wind blowing away from the radar. (The radar location is denoted by the star, which, approximately 20 miles southwest of Minneapolis in Chanhassen).

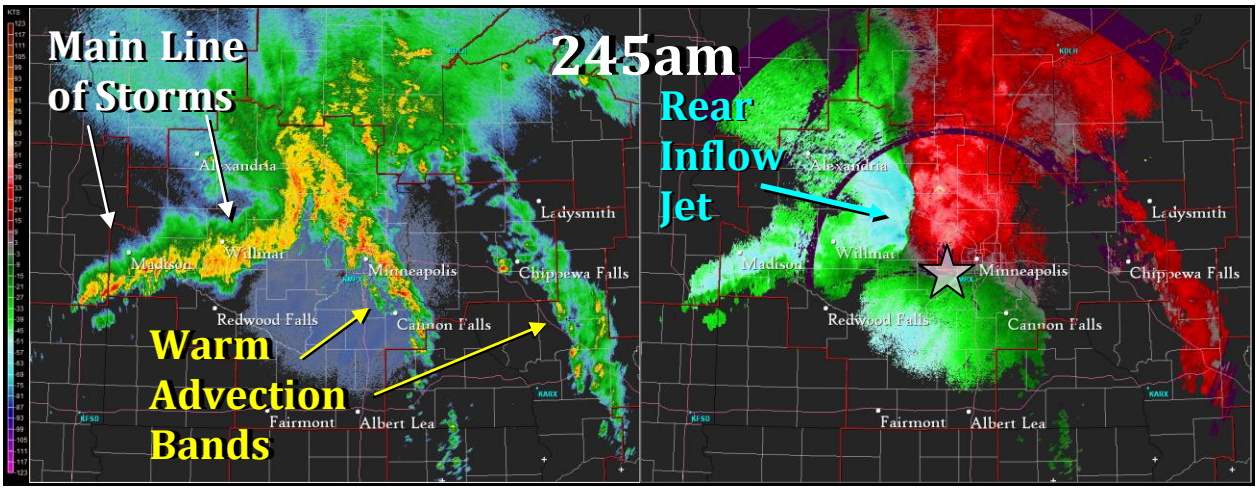

Figure 3: The radar picture from 245am is the same as before and shows base level reflectivity (left) and velocity (right). Notice how the main line of storms has a "bowed" appearance in the reflectivity. Referencing the velocity image, the bright blue colors show winds blowing towards the radar at 85 mph at 2500 ft above ground level. These straight line winds were responsible for the damage that occurred early Friday morning.

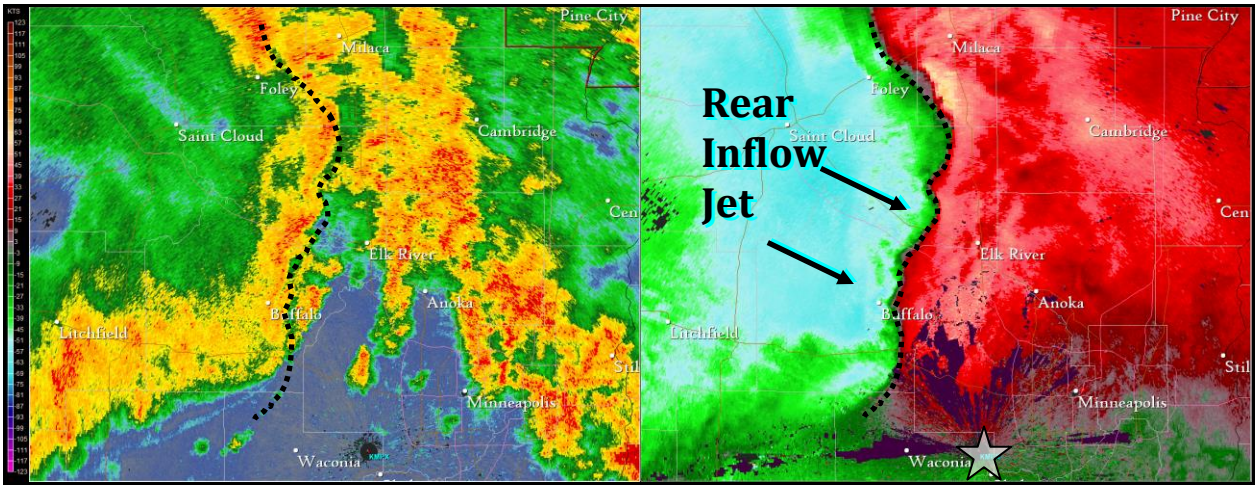

Figure 5: The radar picture from 300 am is zoomed in to show the strong winds. The black line marks the convergence zone between the air flowing into the storm (red) and the high wind gusts that caused the damage (green/blue). It is much easier to identify the damaging features of the storm in the velocity (right) than in the reflectivity (left).

Figure 5: A large tree fell on a truck in Benson MN, which is where the 85 mph wind gust was measured. This is an example of how severe straight line winds can be just as destructive as a weak tornado. *Photo courtesy of the public*

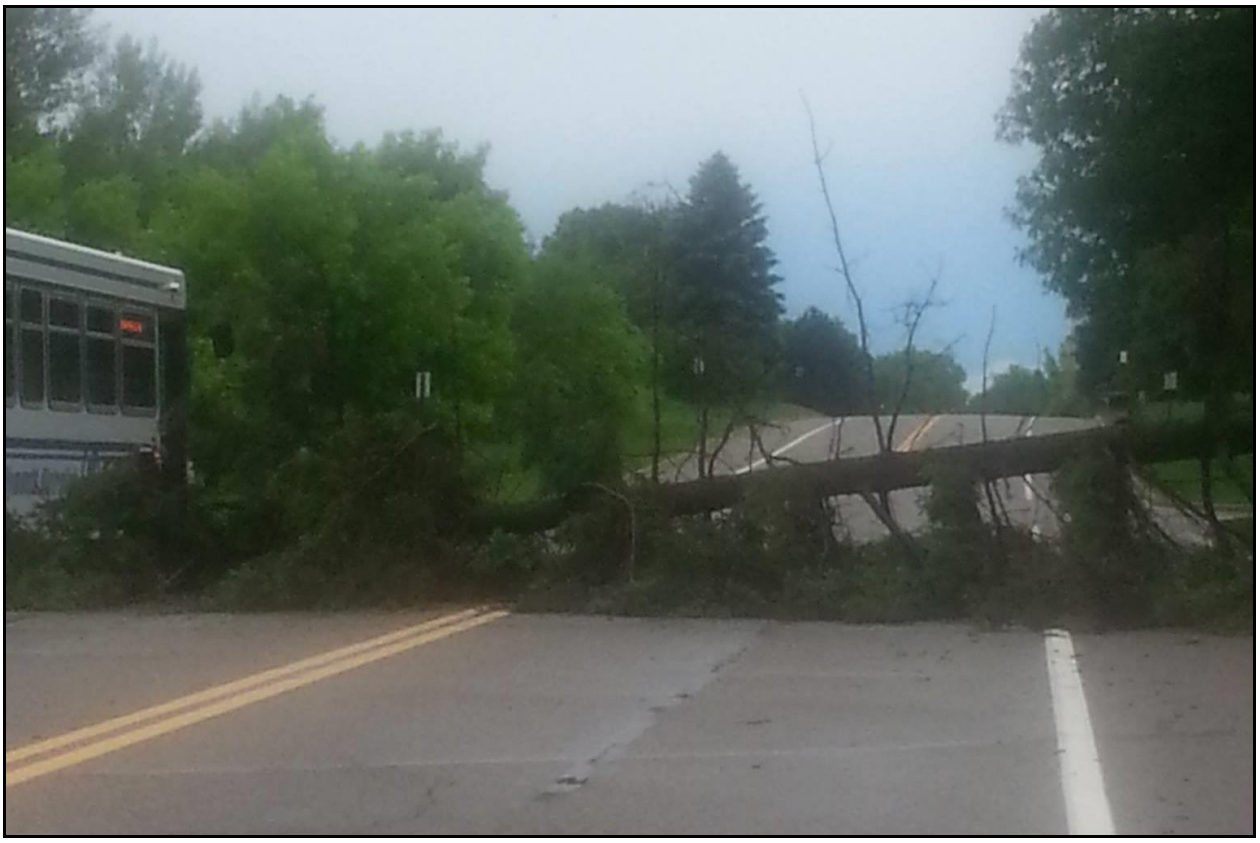

Figure 6: A large tree fell across a road in north Plymouth MN. Traffic lights were also damaged in Plymouth. *Photo courtesy of an NWS employee*